(12) UK Patent Application (19) GB (11) 2 250 384 (13) A

(43) Date of A publication 03.06.1992

(21) Application No 9125006.8

(22) Date of filing 25.11.1991

(30) Priority data
(31) 02327598 (32) 28.11.1990 (33) JP

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(51) INT CL[5]
H02K 3/51 // H02K 3/28

(52) UK CL (Edition K)
H2A AKA3 AKF1 AK108 AK121 AK216R AK302R AK305R AK508

(56) Documents cited
GB 1313944 A GB 1045384 A

(58) Field of search
UK CL (Edition K) H2A AKA3 AKD3 AKE1 AKF1 AKH2A
INT CL[5] H02K 3/28 3/51 13/04

(54) **Securing armature lead wire on insulated commutator base**

(57) A method is disclosed for winding coils so as to secure armature lead wires on a miniature motor of which the armature is of multi-pole construction, and has a commutator disposed on an insulating cylinder (see Fig 5 ref no 5) fixedly fitted to a motor shaft, with tongues for connecting lead wires thereto from the coils. A plurality of coils (2-1, 2-2, 2-3) are wound sequentially on the armature poles, and the trailing end (3b) of the lead wire drawn from the lastly wound coil (2-3) is wound on the insulating cylinder in such a manner that the lead wire intersects and makes contact at least once with all the lead wires (2a, 2b, 1b, 3a) lying between the already wound coils and the commutator tongues.

FIG. 1

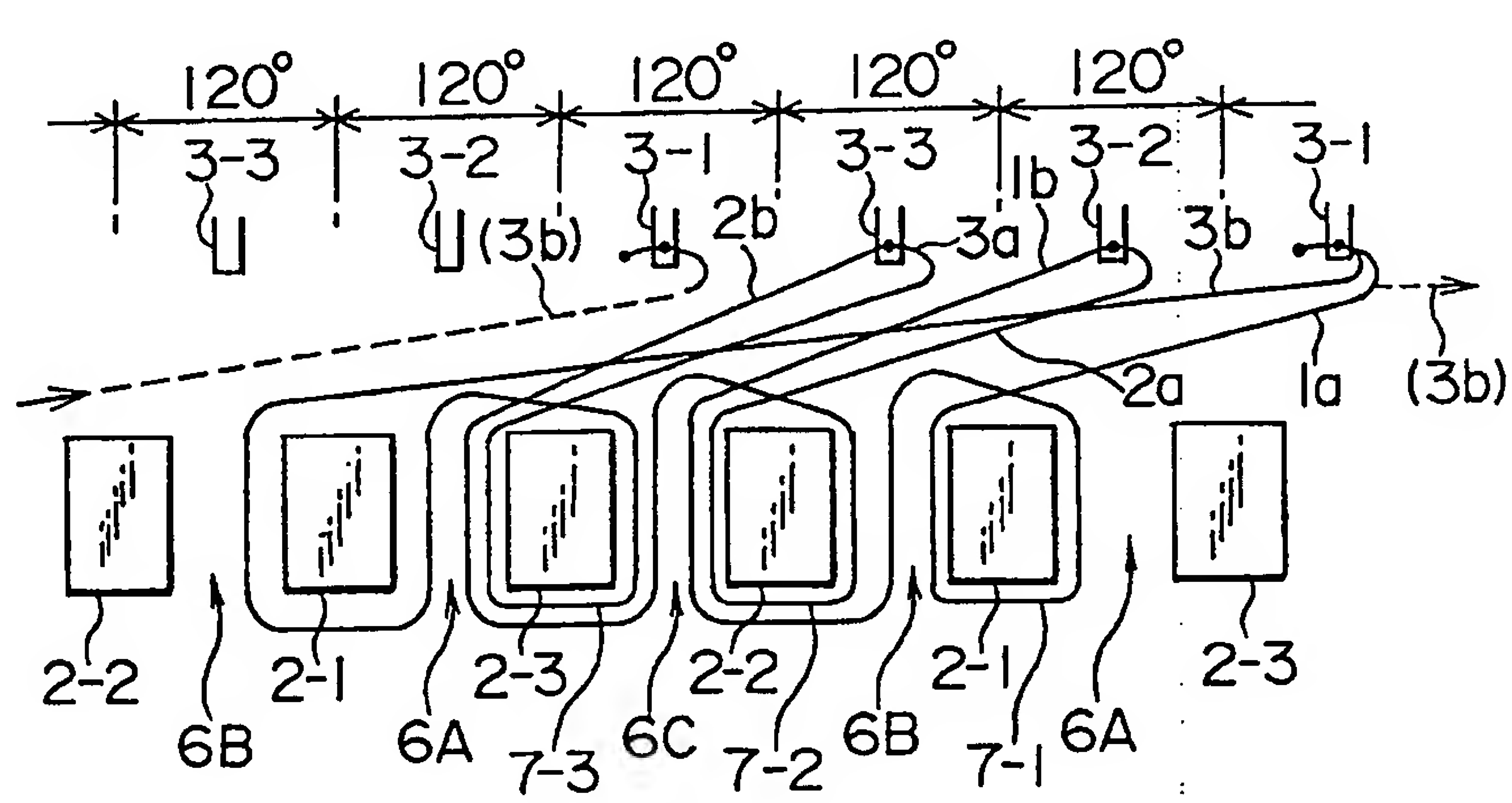

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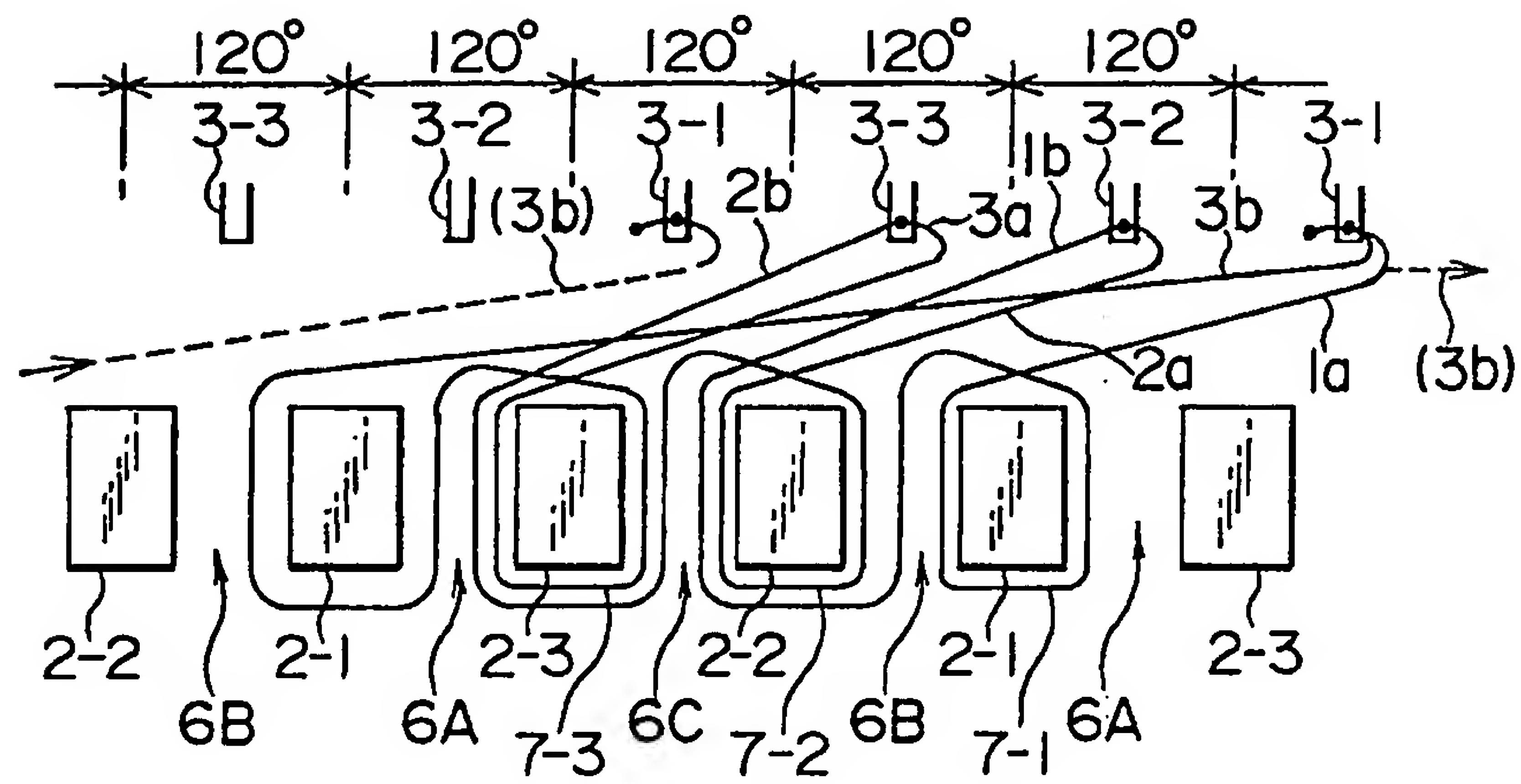
FIG. 1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120°
120°
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(3b)
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1b
3b
2a
1a
(3b)
2-2
6B
2-1
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6C
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6B
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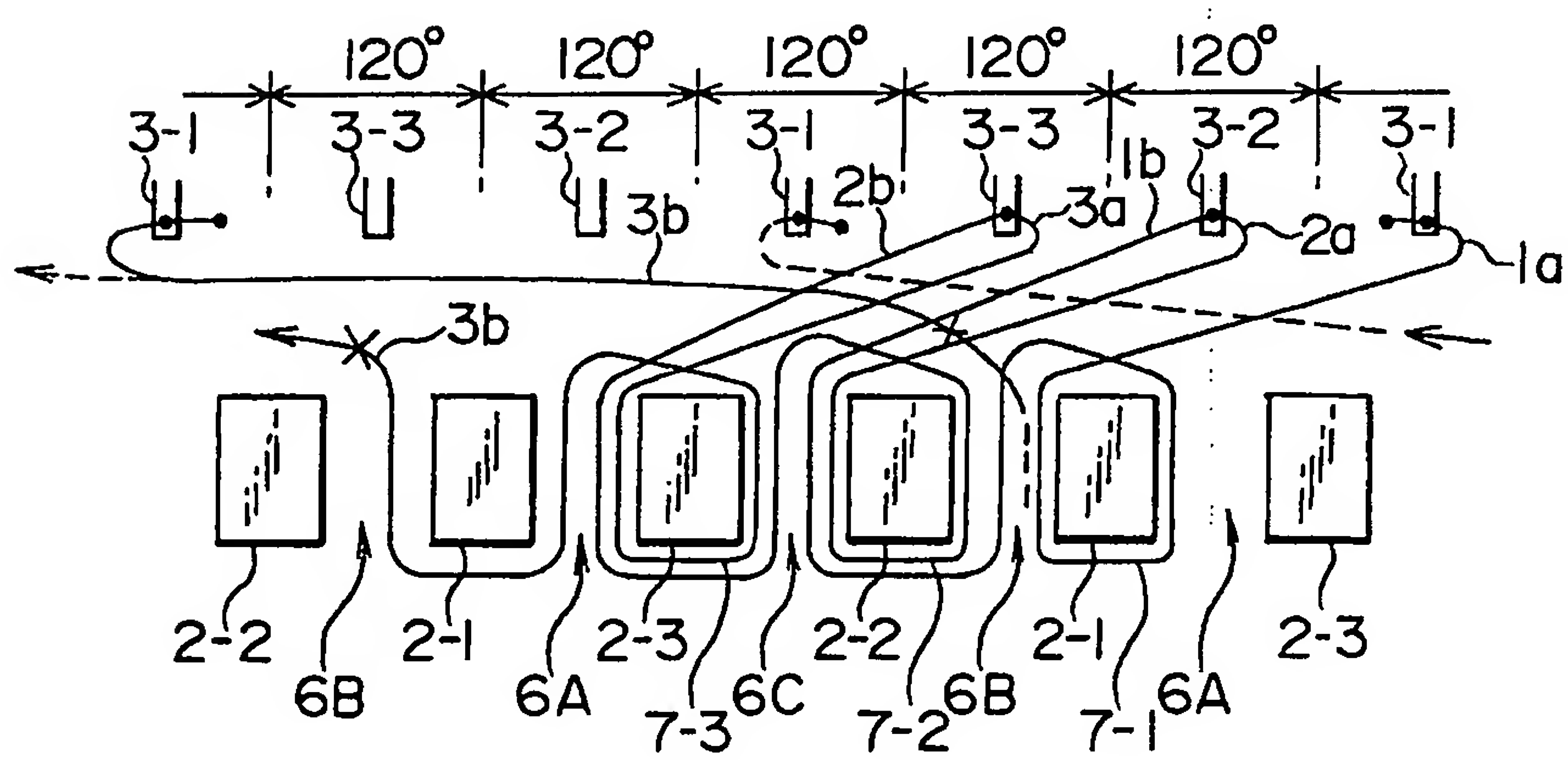
7-1
6A
2-3

FIG. 2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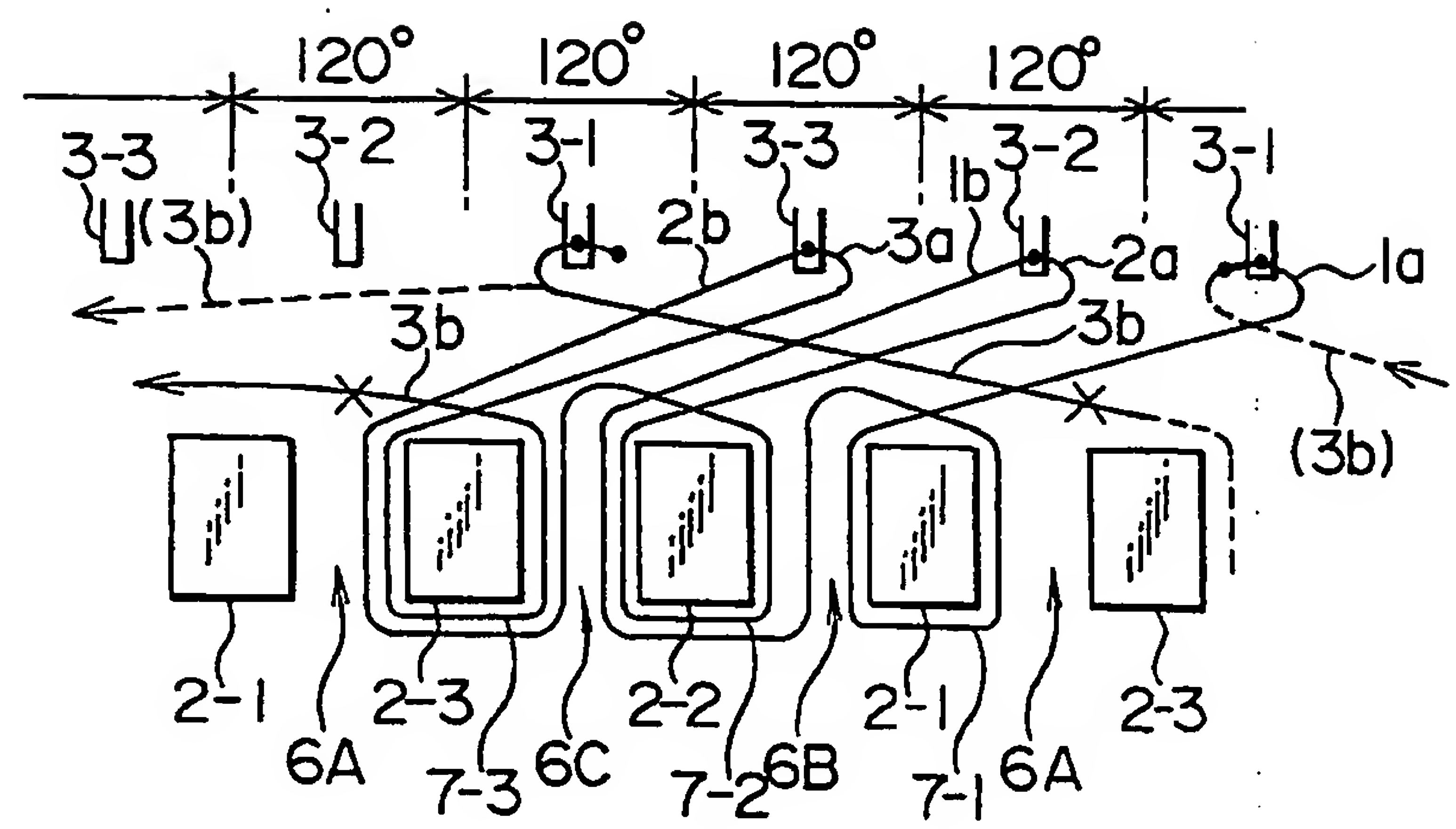
2b
3a
1b
2a
1a
3b
2-2
6B
2-1
6A
2-3
7-3
6C
2-2
7-2
6B
2-1
7-1
6A
2-3

FIG. 3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(3b)
2b
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1b
2a
1a
3b
3b
(3b)
2-1
6A
2-3
7-3
6C
2-2
7-2
6B
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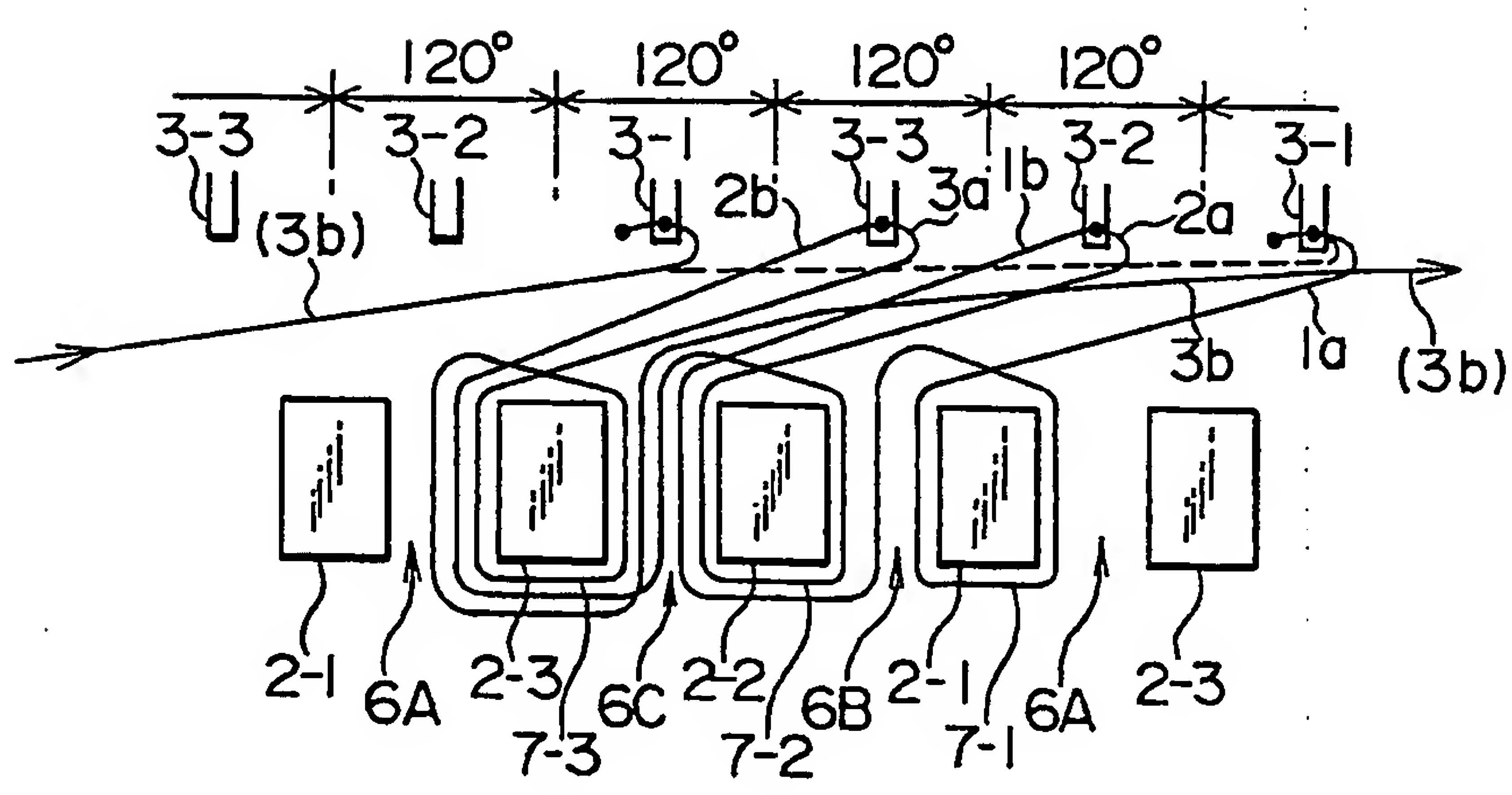
7-1
6A
2-3

FIG. 4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120°
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3-2
3-1
(3b)
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1b
2a
3b
1a
(3b)
2-1
6A
2-3
7-3
6C
2-2
7-2
6B
2-1
7-1
6A
2-3

FIG. 5

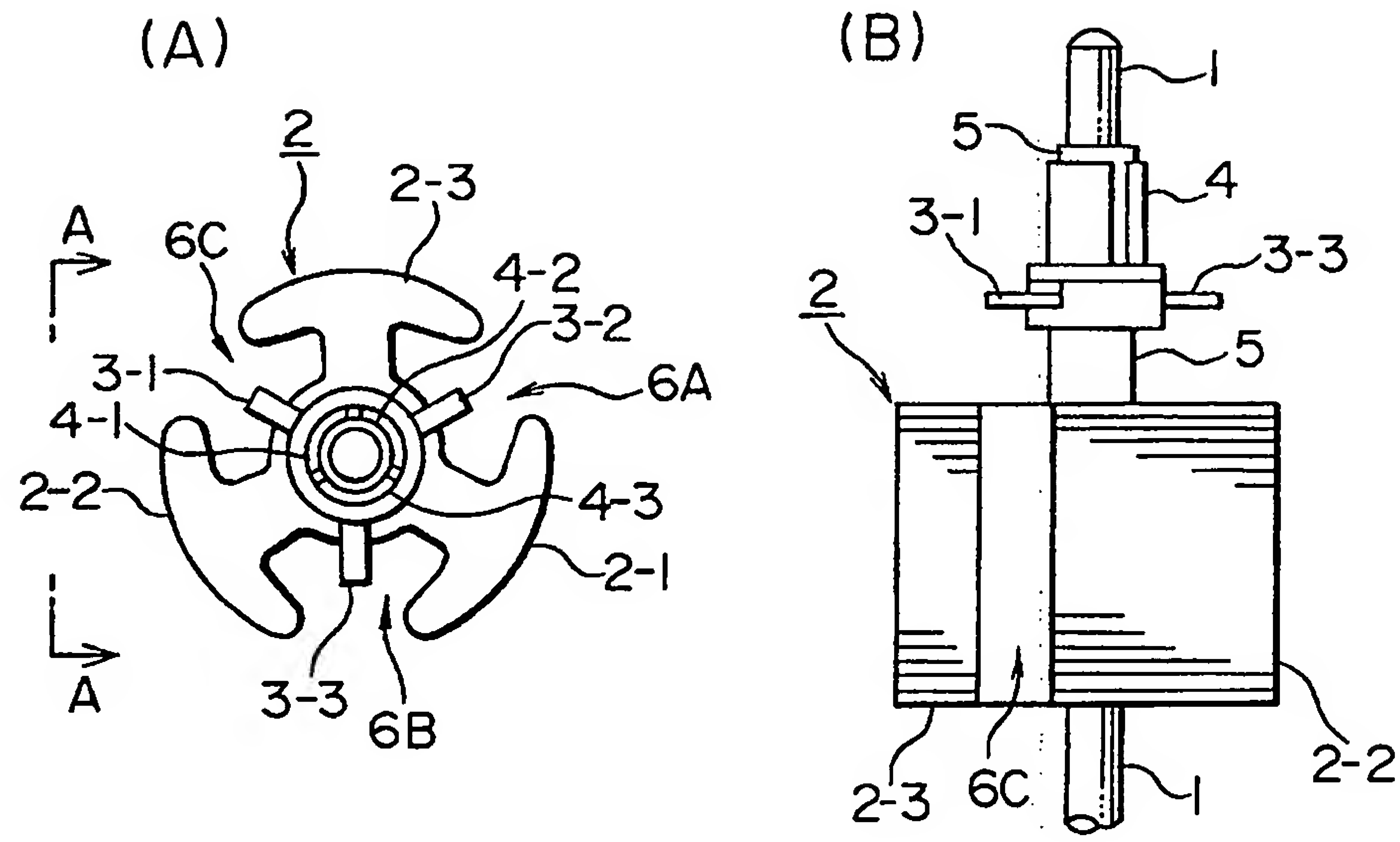
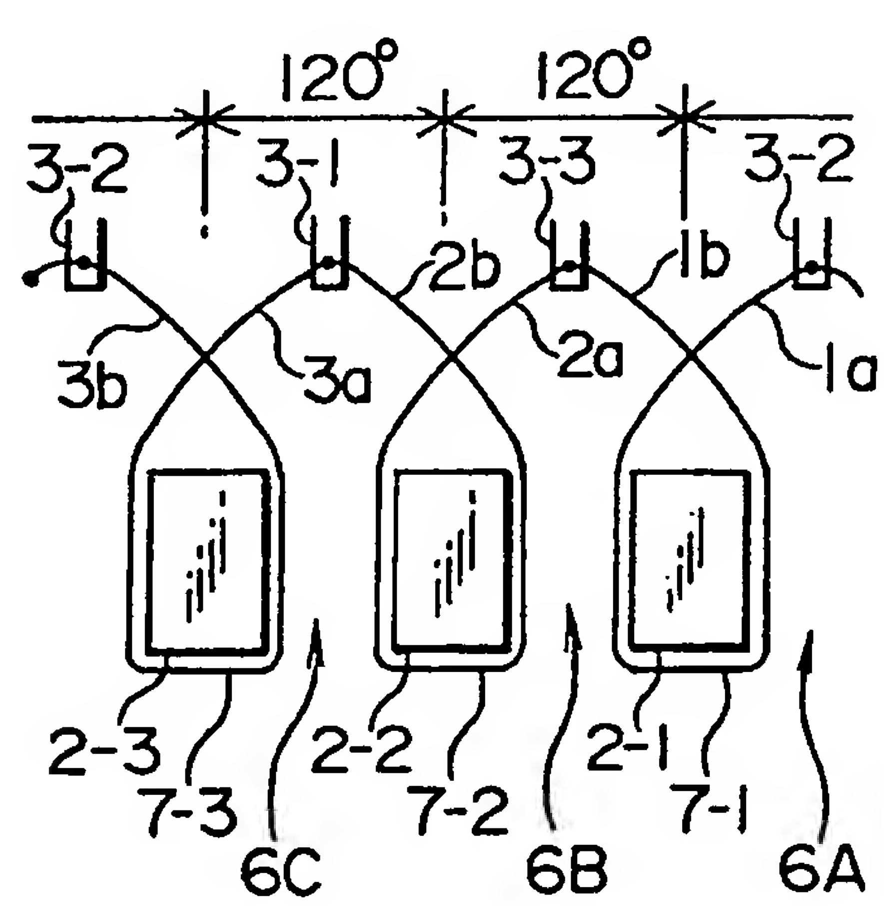

(A)
2
2-3
A
6C
4-2
3-2
3-1
6A
4-1
2-2
4-3
2-1
A
3-3
6B
(B)
1
5
4
3-1
3-3
2
5
2-3
6C
1
2-2

FIG. 6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2b
1b
3b
3a
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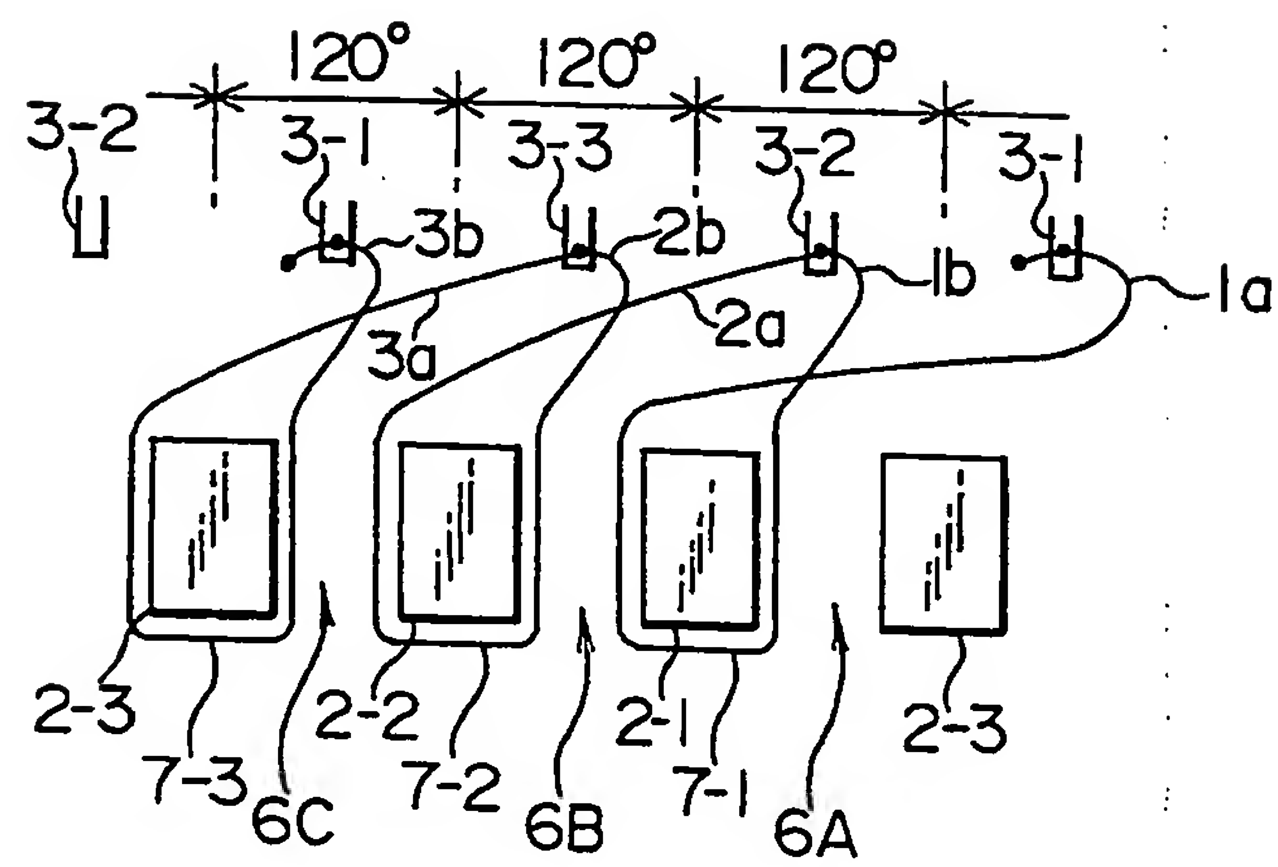
1a
2-3
7-3
6C
2-2
7-2
6B
2-1
7-1
6A

FIG. 7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3b
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1a
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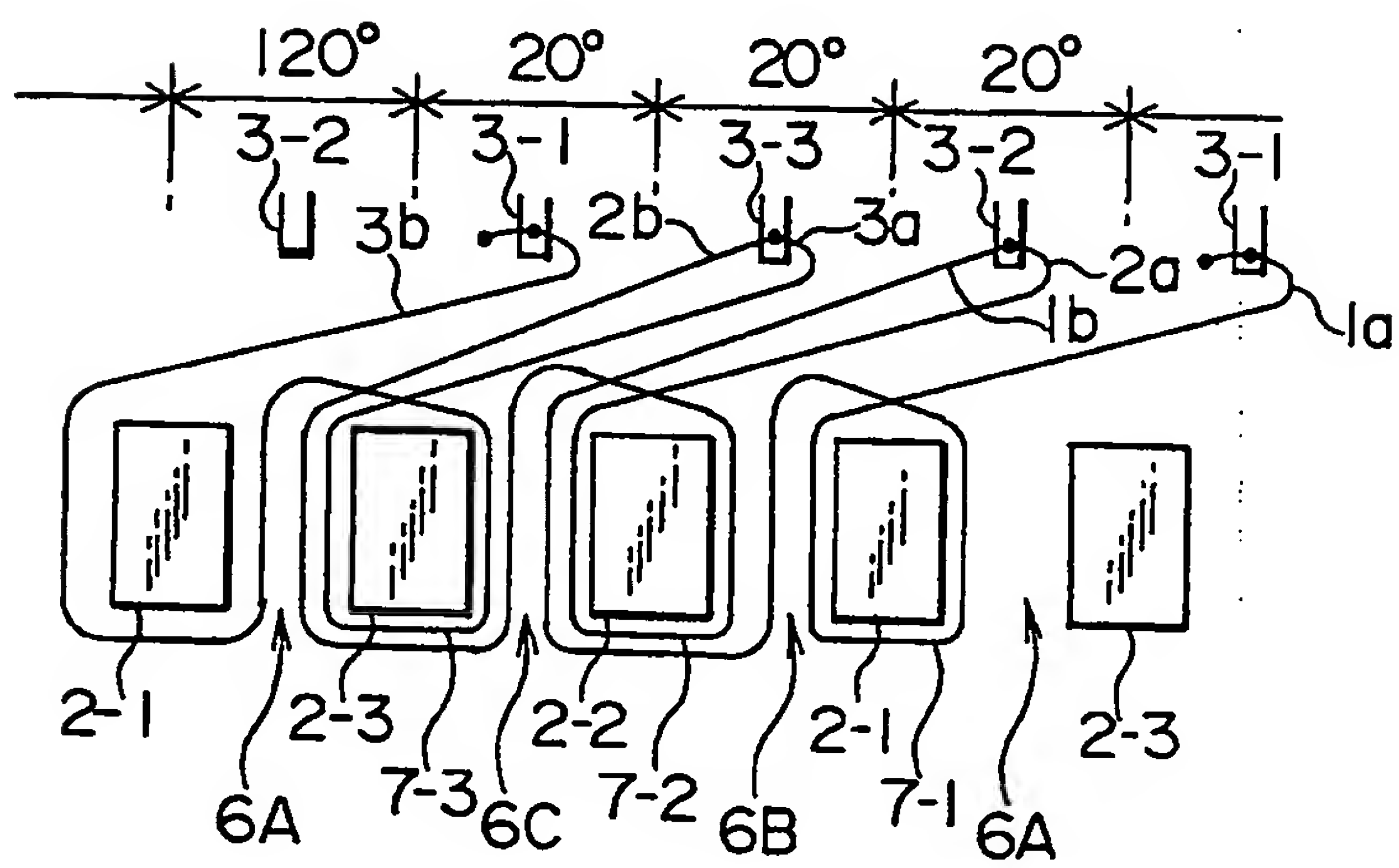
7-1
6A
2-3

FIG. 8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2b
3a
2a
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1a
2-1
6A
2-3
7-3
6C
2-2
7-2
6B
2-1
7-1
6A
2-3

A METHOD FOR WINDING COILS ON AN ARMATURE FOR MINIATURE MOTORS

This invention relates to a method for winding coils on an armature for miniature motors.

In known methods of winding coils on armatures for miniature motors, a plurality of coils are wound sequentially on the poles of the armature core. The wire of the coils is led to and from tongues of commutator segments disposed angularly between the poles to make the requisite electrical connections. The lengths of lead wire between the coils and the tongues are relatively unprotected, and are prone to breakage.

The present invention is directed at a technique for winding coils on the poles of multi-pole armatures in electric motors which provides specific support for the lengths of lead wire referred to above, but which does so with minimal changes in the overall assembly process. The invention makes specific use of the insulating cylinder fitted to the motor shaft, upon which the commutator is disposed. In the method of the invention, a plurality of coils are wound sequentially on the poles of the armature, and a length of lead wire drawn from a lastly wound coil is wound on the insulating cylinder in such a manner that it intersects and makes contact at least once with all other lead wire lengths lying between already wound coils and the commutator tongues, and is connected to a predetermined commutator tongue. In this way, all the lengths of lead wire other than the length drawn from the lastly wound coils can be positively fastened to the insulating cylinder by winding the trailing end of the final lead wire length over the other wires. The effectively extended length of lead wire may be wound in either direction around the insulating cylinder.

Further features and advantages of the invention will be apparent from the following description, both of prior known techniques, and embodiments of the invention given by way of example. Reference will be made to the

accompanying schematic drawings wherein:

Figures 1 to 4 are developed views showing methods of winding coils in accordance with the invention;

Figure 5 shows an end view (A) and a side view (B) of an electric motor shaft with an armature fitted thereto ready for the winding of coils thereon; and

Figures 6 to 8 are developed views showing known coil winding techniques.

Reference will first be made to Figure 5 and the known coil winding techniques illustrated in Figures 6 to 8.

Figure 5 illustrates the assembled rotor of a known miniature motor with an armature of three-pole construction. An iron core 2 having a plurality of poles 2-1, 2-2 and 2-3 (coils wound thereon are not shown) is fixedly fitted to a motor shaft 1. The poles are separated by slots 6A, 6B and 6C. Commutator segments 4-1, 4-2 and 4-3 with respective tongues 3-1, 3-2 and 3-3 are disposed on an insulating cylinder 5 fixedly fitted to the motor shaft 1.

Coils are wound on the armature poles 2-1, 2-2, and 2-3, and the lead wires drawn from the coils are connected to the tongues 3-1, 3-2 and 3-3. Power is fed to the commutators via the commutator segments 4-1, 4-2 and 4-3 and the tongues 3-1, 3-2 and 3-3.

Some conventional coil-winding methods will now be described, referring to Figures 6, 7 and 8. The armature core in these examples has three poles 2-1, 2-2 and 2-3 equally spaced at 120° intervals, with tongues 3-1, 3-2 and 3-3 disposed between them.

In the method of Figure 6, the lead wires drawn from the coils 7-1, 7-2 and 7-3 follow the shortest course to the respective tongues 3-1, 3-2 and 3-3. The coil winding starts at the second commutator tongue 3-2, and wound anti-clockwise on the first armature pole 2-1 to form the first coil 7-1. The trailing end of the lead wire 1b from the first coil 7-1 is connected to the third commutator tongue 3-3. The second and third coils 7-2

and 7-3 are similarly wound anti-clockwise on poles 2-2 and 2-3 from the tongues 3-3 and 3-1 respectively. Although only one torque of each coil is shown, it will be understood that each coil will consist of a predetermined number of turns, as is known. The method of Figure 7 is essentially the same as that of Figure 6 above, except that, as shown in the Figure, the poles 2 and the tongues 3 between which the lead wire extends are displaced by 120°. Consequently, the lead wire lengths 1a, 2a and 3a are brought into contact with the outer circumferential surface of the insulating cylinder 5 over an angular extent of substantially 120°.

The method of Figure 8 differs from that of Figure 7 essentially in that the lead wire is wound on two adjacent poles between connections to commutator tongues. As a consequence, all the lead wire lengths, 1a, 2a, 3a, and 1b, 2b and 3b are extended, and brought into contact with the outer circumferential surface of the insulating cylinder 5.

In the method shown in Figure 6, since all the lead wire lengths take the shortest routes to the commutator tongues 3-1, 3-2 and 3-3, they are all suspended across the coils 7-1, 7-2 and 7-3 and the commutator tongues 3-1, 3-2 and 3-3. This can provoke unwanted problems, such as loosening and breakage, due to the adverse effects of long periods of operation, vibration and shock. The partial contact between the wires and the insulating cylinder 5 in the techniques of Figures 7 and 8 provokes similar difficulties. To meet these, the lead wires are often bonded to the insulating cylinder using adhesive for example. This results in increased manufacturing costs.

The coil-winding process in the embodiment of the invention shown in Figure 1 will be described sequentially. The reference numerals in the Figure 1 correspond with those used in Figures 5 to 8.

First coil-winding process

The leading end of the wire 1a drawn from the first

coil 7-1 is, after connection to the first commutator tongue 3-1, led approximately 240° around the outer circumferential surface of the insulating cylinder 5 in the same direction as the winding direction of the first coil 7-1 (to the left as shown). The winding direction is hereinafter referred to as the planned direction. The wire length 1a is inserted from above into the slot 6B between the first armature pole 2-1 and the second armature pole 2-2, then through the slot 6A and returned to the slot 6B. As a result, the first coil 7-1 is formed on the first armature pole 2-1. The trailing end of the lead wire 1b drawn from the first coil 7-1 is passed through the lower part of the second armature pole 2-2 and the slot 6C, led approximately 240° around the cylinder 5 in the direction opposite to the planned direction (the counter-planned direction), and connected to the second commutator tongue 3-2. Although only one turn of the first coil 7-1 is shown in Figure 1, the first coil 7-1 has a predetermined number of turns. The same holds true with the second and third coils 7-2 and 7-3.

Second coil-winding process

The trailing end of the lead wire 1b of the first coil 7-1 connected to the second commutator tongue 3-2 is, without being cut, led approximately 240° around the outer circumferential surface of the insulating cylinder 5 in the counter-planned direction, inserted into the slot 6C, passed through the slot 6B, and returned to the slot 6C. As a result, the second coil 7-2 is formed on the second armature pole 2-2. The trailing end of the lead wire 2b drawn from the second coil 7-2 is, after passing around the lower part of the third armature pole 2-3 and through the slot 6A, led approximately 240° in the counter-planned direction, around the cylinder 5, and connected to the third commutator tongue 3-3.

Third coil-winding process

The trailing end of the lead wire 2b of the second coil 7-2 connected to the third commutator tongue 3-3 is,

without being cut, led approximately 240° around the insulating cylinder 5 in the planned direction, inserted into the slot 6A, passed through the slot 6C, and returned to the slot 6A. As a result, the third coil 7-3 is formed on the third armature pole 2-3. The trailing end of the lead wire 3b of the third coil 7-3 is, after passing through the slot 6A, around the lower part of the first armature pole 2-1 and through the slot 6B, led around the insulating cylinder 5 by approximately 600° in the counter-planned direction (as shown by solid lines in the figure), and connected to the first commutator tongue 3-1. The trailing end of the lead wire 3b of the third coil 7-3 may be extended by 360° (that is, one full turn) or multiples thereof before being connected to the first commutator tongue 3-1.

In the embodiment of Figure 1 all the windings are wound on the armature by following the coil-winding processes described. With this method, all the other lead wires can be tightly fastened and positively secured to the insulating cylinder 5 by the lead wire of the final coil, that is, the lead wire 3b of the third coil 7-3.

The embodiments of Figures 2, 3 and 4 are essentially the same as the embodiment shown in Figure 1, except for the path followed by the lead wire 3b from the third coil 7-3.

In the embodiment shown in Figure 2, the trailing end of the lead wire 3b of the third coil 7-3 is passed through the slot 6A, around the lower part of the first armature pole 2-1 and through the slot 6B. It is then led approximately 480° around the insulating cylinder 5 in the direction opposite to that in the embodiment shown in Figure 1 (as shown by solid lines), and connected to the first commutator tongue 3-1 (the mark X in Figure 2 shows the same position on the lead wire 3b for the sake of convenience). Alternatively, the third lead wire 3b wound in the aforementioned manner is, without being connected to the first commutator tongue 3-

1, extended further by 360° (as shown by dotted lines), or multiples thereof and connected to the first commutator tongue 3-1.

In the embodiment of Figure 3, the trailing end of the lead wire 3b of the third coil 7-3 is wound on the third armature pole 2-3, and led approximately 360° around the insulating cylinder 5 in the direction opposite to that in the embodiment of Figure 1 (as shown by solid lines), without passing through the slot 6A, and then connected to the first commutator tongue 3-1 (the mark X in Figure 3 shows the same position on the lead wire 3b for the sake of convenience). Alternatively the third lead wire 3b wound in the aforementioned manner is, without being connected to the first commutator tongue 3-1, extended by 360° (as shown by dotted lines), or multiples thereof, and then connected to the first commutator tongue 3-1.

In the embodiment of Figure 4, the trailing end of the lead wire 3b drawn from the third coil 7-3 is wound on the third armature pole 2-3, passed through the slot 6A, around the lower part of the third armature pole 2-3 and the slot 6C, and extended by approximately 720° in the same direction as that in the embodiment shown in Figure 1; that is, in the planned direction (as shown by solid lines). It is then connected to the first commutator tongue 3-1. Alternatively, the third lead wire 3b wound in the aforementioned manner is, without being connected to the first commutator tongue 3-1, extended by 360° (as shown by dotted lines), or multiples thereof, and connected to the first commutator tongue 3-1.

In the embodiments of the invention shown in Figures 1 to 4, all the other lead wires are tightly fastened and positively secured to the insulating cylinder 5 by the lead wire drawn from the final coil; that is, the lead wire 3b of the third coil 7-3. It will be appreciated that the method of the invention is not limited to an armature of a 3-pole construction as illustrated in

Figure 5, but may be applied to any armature of multi-pole constructions and to armatures having lap-wound coils.

As described above, methods according to the invention can improve the stability of lead wires between the commutator tongues and the coils, and particularly provide the following benefits:

The risk of breakage of lead wires due to motor speed, vibration, impact, etc. is reduced since loosening and lifting of lead wires is inhibited.

The risk of loosening, unwinding, and lifting of the coils themselves is reduced due to the better stability of the lead wires.

Adhesive and bonding processes for fixing lead wires are no longer required which reduces the time and labour involved in the manufacturing process, contributing to improved production efficiency and reduced cost.

The invention thus facilitates the production of high quality and reliable miniature motors at an economic cost.

CLAIMS

1. A method for winding coils on an armature for miniature motors which armature is of multi-pole construction and has a commutator disposed on an insulating cylinder fitted to the motor shaft, with tongues for connecting lead wires of said coils thereto wherein a plurality of coils are wound sequentially on the poles of the armature, and a length of lead wire drawn from a lastly wound coil is wound on the insulating cylinder in such a manner that it intersects and makes contact at least once with all other lead wire lengths lying between already wound coils and the commutator tongues, and is connected to a predetermined commutator tongue.

2. A method according to Claim 1 wherein a lead wire length drawn from the lastly wound coil is passed through a first slot between adjacent armature poles, around the lower part of a first armature pole and through a second slot, and wound around substantially 600° of the outer circumferential surface of the insulating cylinder, before being connected to a first commutator tongue.

3. A method according to Claim 1 wherein a lead wire length drawn from the lastly wound coil is passed through a first slot between adjacent armature poles, around the lower part of a first armature pole and through a second slot, and wound around substantially 480° of the outer circumferential surface of the insulating cylinder before being connected to a first commutator tongue.

4. A method according to Claim 1 wherein a lead wire length drawn form the lastly wound coil is wound around substantially 360° of the outer circumferential surface of the insulating cylinder before being connected to a first commutator tongue.

5. A method according to any preceding Claim wherein the lead wire length drawn from the lastly wound coil is wound round the insulating cylinder in direction opposite to the sequence in which the coils have been wound.

6. A method according to Claim 5 wherein a lead wire length drawn from the lastly wound coil is passed through a first slot, the lower part of a last armature pole, and a last slot, and then wound around substantially 720° of the outer circumferential surface of the insulating cylinder before being connected to a first commutator tongue.

7. A method according to any preceding claim wherein the lead wire length drawn from the lastly wound coil is extended to make at least one additional turn around the insulating cylinder.

8. A method of winding coils on an armature for a miniature motor, substantially as described herein with reference to any of Figures 1 to 4 of the accompanying drawings.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

Application number
9125006.8

Relevant Technical fields

(i) UK Cl (Edition K) H2A (AKE1,AKH2A,AKD3,AKF1, AKA3)

(ii) Int Cl (Edition 5) H02K 13/04,03/51,03/28

Search Examiner
J COCKITT

Databases (see over)

(i) UK Patent Office

(ii)

Date of Search
29 JANUARY 1992

Documents considered relevant following a search in respect of claims 1-8

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
A	GB 1313944 A (HONEYWELL)	
A	GB 1045384 A (VAN DER HEEM)	

Category	Identity of document and relevant passages	Relevant to claim(s)

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